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EUTROPHICATION, A THREAT TO SALINE LAKE IN A CRATER AT LONAR, MAHARASHTRA

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The Beautiful picturesque of Lonar Lake

ABSTRACT

Lonar lake ($19^{O}58$'N and $76^{O}31$'E) is a meteoritic impact crater lake that has no outlet. Uniqueness of the lake is its salinity and alkalinity. The saline lake, marshy areas around it, freshwater streams, natural and manmade plantations, crop fields and the remnants of the original forest and scrub referred to above, all provide special niches for plants, animals and thus, become an important biodiversity sector. As it is brine, the microbial flora and fauna of the lake basin is still more important.

The fascinating physical setup of Lonar crater, its relative isolation and the, morphometry, hydrography, Limnological, Ecological status evolve in a unique way due to the unusual geographical and hydrological and climatic isolation. Unfortunately, deteriorating changes in hydrology of the lake due to input of sewage of Lonar town and agriculture inside the crater on alluvium it is leading towards Eutrophication consequently, reduction of macrophytes and phytoplankton diversity and increase in pathogenic organisms. If appropriate steps are not followed in near future for the conservation and protection of this unique ecosystem, it will be lost forever.

In present paper the reasons for pollution and degradation of lake, its causes such as human interventions, exploitation of water resources, threat to wetland biodiversity, need of preservation of wetland habitat with diversity, the parameters which are indicators of eutrophication, reasons for the eutrophication, remedy for the conservation of the lake, required management steps both at the wetland site and at watershed area, comprehensive conservative measures will be discussed.

Introduction

The Lake (Fig.1) embraced by crater of Lonar is unique and valuable ecosystem. It is biologically diverse and supports large number of endemic and threatened species. It is of great economic and cultural importance and serves as a source of salts, recreation and tourism.

Concept of eutrophication was first introduced by Weber, 1907. Eutrophication is the response in water due to over enrichment by nutrients, primarily phosphorus and nitrogen, and can occur under natural or manmade (anthropogenic) conditions. Eutrophication is a global phenomenon associated with nutrient enrichment

of aquatic ecosystems. In natural course it is slow process of lake ageing which ultimately leads to succession. Eutrophication of fresh water has assumed global dimension adversely affecting the use of water[11,13,25,31]. Eutrophication level of water body may be judged by several factors that include both physico-chemical and biological. `Manmade' (or cultural) Eutrophication, in the absence of control measures, proceeds at an accelerated rate compared to the natural phenomenon and is one of the main forms of water pollution. Meybeck et al[24] highlighted that eutrophication is the naturally occurring process, but it has been accelerated in recent times due to excessive man induced activities around the aquatic system. The resultant increase in fertility in affected lakes, reservoirs, slow-flowing rivers and certain coastal waters causes symptoms such as algal blooms, heavy growth of rooted aquatic plants (macrophytes), algal mats, deoxygenation and, in some cases, unpleasant odor, which often affects most of the vital uses of the water such as water supply, recreation, fisheries (both commercial and recreational), or aesthetics. In short, manmade Eutrophication of inland bodies of water becomes synonymous with the deterioration of water quality and as such frequently causes extra economic costs as well as depreciation in property values. However, man is responsible for accelerating the process many folds endangering the very survival of water bodies all over the world.

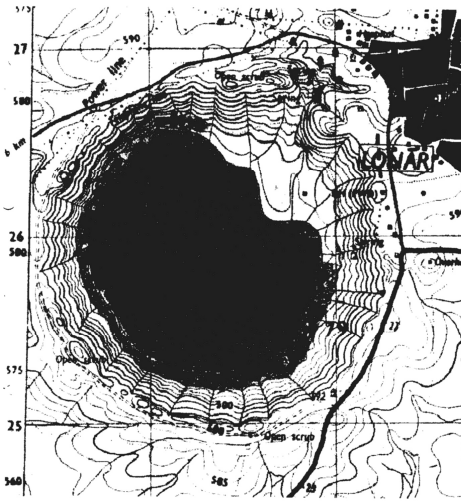

Fig. 1. Topograph Lonar lake (19^{O}58'N and 76^{O}31'E)

Materials and Methods

Limnological investigations: The water samples were collected for a period of successive three years (2000-03) from four collection sites which were named Site I, Site II, Site III and Site IV, located at East, South, West and North sides of the lake respectively. The water collected from different sites was mixed together to obtain one composite sample for physico-chemical analysis. The water quality parameters analyzed using the described methods by APHA[2]. The temperature, conductivity and salinity were measured with the help of Systronics CST meter.

Results and Discussion

Lonar Lake has a localized temperature system as it is being subterranean hollow closed from all sides; the lake basin is partly screened from direct sun light at different places and at different times of the day.[20]

Water quality: TDS- 10975 mg/L, conductivity- 23300 mmhos/m, DO- 2.98 mg/L, Total Alkalinity -1580 mg/L, Chlorinity- 2750 mg/L, Hydrogen sulphide- 6.5 mg/L, Total hardness - 250 mg/L, Nitrates 10.97 mg/L, Ammonia - 10.69 mg/L, Phosphate - 2.72 mg/L, BOD) -152. mg/L, and Gross Primary Productivity (GPP) – 6.086 g /m^2/day[5,15]depicts eutrophication status of lake in terms of volume and impact a single factor affecting the tropic status of water bodies is domestic sewage. Nutrient enrichment directly affects the water quality and leads to a number of consequences indicative of imbalance in the ecosystem. Deposition rate of nitrogen and phosphorus reflect the eutrophication. Evidently, in case of nutrient enrichment, the rates of synthesis and the organic loading exceed the rate of recycling and out-put[27, 28]. Kodarkar [12] also reported lakes in urban environments, nutrient loading is mainly from domestic sewage, and sediments of eutrophic reservoirs are rich in two key nutrients nitrogen and phosphorus. Eutrophication is when the environment becomes enriched with nutrients. This can be a problem in lake habitats as it can cause algal blooms. The first and most visible symptom of nutrient enrichment is prolific growth of algal communities (primary producers) producing mono or poly-specific blooms. Normally a small numbers of taxonomic groups are well adapted to heavy pollution loading and consequent alterations in the physicochemical conditions

and biogeochemical and energy cycles in an ecosystem. The main groups of hypertrophic and phytoplankton are *Cyanobacteria*, Phytoplankton diversity, biomass, productivity and periodicity are controlled by a number of physical, biochemical and biological and biological factors operating at a complex level in an ecosystem. Organically bound nutrients were released during its decomposition. Nitrogen present in soil in organic form gradually got mineralized into ammonium and nitrate, making it available to biotic communities. Evidently it was the total nitrogen of bottom sediment, especially in the shallower lake, dictated the productivity [29]. The nutrients responsible for Eutrophication are Nitrates (NO_3) and Phosphates (PO_4) their impacts are extremely varied and potentially destructive [9,10,27]. Nitrates and phosphates in a body of water can contributed to high BOD levels. These are plant nutrients and can cause plant life and algae to grow quickly. They also die quickly. This contributes to the organic waste in the water which is then decomposed by bacteria. This results in the high BOD level. Thus, 105 to 200 mg/L BOD values of the lake water also indicate its high degree of eutrophication.

Deteriorating changes in hydrology of the lake due to input of sewage of Lonar town and agriculture inside the crater on alluvium is the main cause of its Eutrophication because it increases its nutrition level. Increased inflow of water through high precipitation followed by subsequent input from the perennial springs and a human induced increase of nutrients into lake due to farming on the alluvial patches of crater are the probable causes of eutrophication. Similar reasons for the eutrophication of Lonar lake were also investigated[3].

Though Level of nitrates and phosphates were essential for the growth of primary producers, it disrupted normal ecosystem of the lake and created many problems because of algal bloom. Low oxygen level in Lonar lake is only because it is used by *Spirulina* and zooplanktons, leaving no for other life in the lake.

This results in the death of many aquatic organisms, which need the oxygen in the water to live, consequently reduction of macrophytes, macroinvertebrates, phytoplankton and increase in pathogenic organisms. Primary productivity value of Lonar lake is at alarming level. According to Agrawal[1], due to eutrophication in lake, rate of gross primary production may increase from 0.5 to 5.0 g/m^2/day during most favorable growing season.

Fig.2: Algal blooms

Fig. 3: Spirulina scum

Fig. 4: Cattle grazing

The eutrophic lake largely supports the growth of few phytoplanktons like blue green algae (Fig. 2 & 3), *Mycrocystis, Anabaena, Phormidium, Oscillatoria, Spirullina, Lyngbya,* etc., *Diatoms Asterionella, Fragillaria, Cyclotella, Melosira, Tabellaria* etc., green algae *Chlorella, Ankistrodesmus, Scenedesmus, Eudrina, Stigeoclonium* etc and some *euglenoids*[1]. Nandan et al.[26] have studied eutrophication using algae as an indicators. These algae algae along with *Spirulina* even produce toxins that are harmful and can cause problems along the food chain and affect any animal that feeds on them. These deteriorating changes in hydrology of the lake are only due to input of sewage of Lonar town and agriculture inside the crater on alluvium is the ultimate cause of its Eutrophication.

The human interventions, such as cattle grazing (Fig. 4) agriculture on the alluvium,

deforestation, plantation of *P. juliflora* and subsequent exploitation of biomass cause increase in human activity which in turn result in accumulation of organic content into the lake. The exploitation of water resources, the sweet water streams which are the principle inlets of lake are diverted for the agricultural practices in the alluvial fan. These waters loaded with nutrients due to used fertilizers in fields ultimately through percolation get added to the lake water. Water and land use pattern[21], particularly were the responsible factors. Banerjea[4] reported similar observation in the pond ecosystem.

Fig.5: Lake view

Fig. 6: Brahmni shelducks

Conclusion

All the parameters which are indicators of eutrophication were found to be at peak level. If the immediate measures are not effectively taken we may lose the lake and its wetland biodiversity to a great extent.

Preservation of wetland habitat with all such diversity of organisms is necessary. This requires management steps both at the wetland site and at watershed area. It will be possible only through consideration of views of all the concerned for making the assessment and formulating the comprehensive conservation measures.

Following are the methods which may reverse the eutrophication effects.

- Minimizing nutrient input waste water by treating before its discharge into lake.
- Removal of dissolve nutrients from lake water by physical or chemical methods for example, phosphorus can be removed by precipitation, nitrogen by biological nitrification and denitrification or by air stripping of NH_3 from an alkalized waste water or by ion exchange, electrodialysis or by reverse osmosis.
- Nevertheless, nutrients level of standing water can effectively be reduced by periodically harvesting and removal of algal blooms and macrophytic biomass, to stimulate bacterial multiplication in order to reduce the amount of nutrients solubilised in water would help disruption of algal food web would check recycle of the nutrients into the lake. One of the basic approaches in controlling blooms is prevents and control of nutrients loading from point sources.

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